

A Critical Analysis of the Effectiveness of Peer Review Strategies of Mathematics and Sciences Pedagogy in Secondary School in Kenya

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Abstract: Recent calls for science teachers by the ministry of education (MOE) and teachers' service commission to engage in the lesson study have left many in the education sector questioning whether teachers are prepared and ready to embrace it. The performance of mathematics and sciences depicted in any school in Kenya are largely influenced by the quality of teaching exhibited by science teachers. Likewise the overall grade scored by a student in the national examination (KCSE) largely depends on the performance of mathematics and sciences. Effective teamwork and networking among science teachers in a school is a source of motivation that drives students towards achieving good grades. Center for Mathematics Science and Technology Education in Africa (CEMASTE) headquarter located in Nairobi, Kenya has taken initiative to train science teachers in Kenya in collaboration with JICA in Japan to carry out lesson study. This article is intended to critically analyze the effectiveness of peer review strategy that is lesson study in secondary schools and to make recommendations on the best way possible. Teachers do in fact encounter difficulties merging their lesson study and meeting their professional responsibilities. It also intends to investigate the extent to which lesson study is carried out by mathematics and science teachers in secondary schools, what stands on the way of teachers taking advantages of lesson study and how such obstacles can be overcome and addressed.

Key words: Center for Mathematics, Science and Technology Education in Africa, Lesson Study, Mathematics, sciences, science teachers.

1.0.INTRODUCTION

Over the past decades, ministry of education has called for improvement in performance of mathematics and science in secondary schools. In order to achieve vision 2030 objectives, it was found necessary to promote mathematics and sciences in secondary schools. There was need to enhance learner growth in mathematics and sciences and to achieve this, there was need to in-service mathematics and science teachers. The Center for Mathematics Science and Technology Education in Africa (CEMASTE) was given the mandate of implementing teacher capacity development programmes mainly through in-service education training for practicing teachers of mathematics and science. This led to introduction of SMASE INSETS and lesson study to practicing mathematics and science teacher. Strong criticisms have been made about the ability of implementing lesson study in Kenya secondary schools. It is helps teachers to grow professionally and collaboratively are involved in planning and examining actual implementation of lesson in the classroom. It involves Planning – a group of teachers make a lesson plan, Doing – one teacher (model teacher or demonstration teacher)

conducts a lesson based on the plan as colleagues observes the lesson, seeing – teachers reflect on the observed lesson together and finally they improve on the lesson.

It is therefore a professional development where a team of teachers come together collaboratively plan, review their lesson instructions in order to determine how students will improve their on their learning and performance. Therefore, it is a professional learning approach that dramatically improves learning and teaching of students. In Japan teacher improve their teaching through lesson study. They are involved in planning, observing, analyzing and refining actual classroom lesson. In US setting, lesson study has been conducted in school, districts and pre-service education.

Lesson study in Kenya is carried out in secondary school by mathematics and science teachers. Teacher Capacity Development system for mathematics and science teachers at secondary education cycle in Kenya has been institutionalize at CEMASTE. The situational analysis findings and subsequent lesson observation studies conducted by CEMASTE reveals weak practice of ASEI-PDSI in the classroom (CEMASTE 2009 and 2013). Lesson study was identified as one of the strategies that would assist in entrenching the practice of ASEI-PDSI at school level. In order to implement lesson, school principals, quality assurance and standard officers, deputy principals and head of departments have been sensitized on lesson study in various workshops since the year 2010. In the year 2014, during National Inset an action plan was drawn to implement lesson study in all Kenyan secondary schools.

2.0.STATEMENT OF THE PROBLEM

Observation on the monitoring and evaluation report (CEMASTE 2015) show that teacher were expected to implement lesson study programmed for four days in school, but some counties took one to two days. It was evident that teacher were not able to differentiate between a theme and lesson study. Teacher need to further refine problem statement process and strategies used to teach frequency.

3.0.PURPOSE OF THE STUDY

This article critically analyzes the effectiveness of peer review strategy on mathematics and science pedagogy in secondary school in Kenya. How the quality of the lesson study in terms of organization and management affect the implementation process. Look the extent of implementation and come up with a way forward on lesson study.

4.0.RESEARCH OBJECTIVES

This critical analysis on the effectiveness of peer review strategy on mathematics and science pedagogy in secondary school in Kenya is guided by the following objectives:

- I. To critically analyze effectiveness of planning on mathematics and sciences pedagogy in secondary school in Kenya.
- II. To critically analyze the effectiveness of resource materials used in teaching and learning mathematics and science in secondary schools in Kenya.
- III. To critically analyze the effectiveness of lesson implementation in mathematics and sciences in secondary school in Kenya.
- IV. To critically analyze the effectiveness of reflection stage on mathematics and science pedagogy in secondary school in Kenya.
- V. To critically analyze the effectiveness of improvement stage on mathematics and science pedagogy in secondary school in Kenya.

5.0. RESEARCH QUESTIONS

- I. How does effective planning affect peer pedagogy in mathematics and science in secondary school in Kenya?
- II. To what extent do effective teaching and learning material affect peer pedagogy on mathematics and science in Kenya?
- III. Is there effective lesson implementation in peer pedagogy in mathematics and science in secondary schools in Kenya?
- IV. Do teachers have effective reflection after peer pedagogy in mathematics and sciences in secondary school in Kenya?
- V. Is there an effective improvement in teaching and learning mathematics and sciences in secondary school in Kenya?

6.0. SIGNIFICANCE OF THE STUDY

This article is meant to urge secondary school teacher to embrace peer pedagogy (lesson study) in teaching and learning of mathematics and sciences in secondary schools in Kenya. To promote lesson improvement in classroom, help teacher in professional growth and post good results.

7.0. RESEARCH METHODOLOGY

Qualitative research methodology was employed together with critical analysis design into effectiveness of peer review strategy in mathematics and sciences pedagogy in secondary schools in Kenya. This analysis will be used to come up with the recommendations on what should be done to improve implementation of lesson study in the area of quality of facilitation in terms of planning, implementation, reflection and effective use of learning resources.

8.0. LITERATURE REVIEW

8.1 A critical analysis of the effectiveness of planning on mathematics and science peer review pedagogy

The objective of planning in lesson study is to help the teachers to achieve both the long term and short term goal in learning and teaching of students. A group of teachers work together to come up with a lesson study theme, the first step is planning. Teachers undertake the following; choose lesson study theme, focus on the lesson study and create the lesson.

There are various questions that need to be answered during planning stage. Teachers need to look at what currently students understand and deficiency in the topic, what students need to know before lesson implementation, teaching and learning points, the material needed for the lesson, activities of the teacher and activities for the students, problems and misconceptions during lesson implementation and how the teacher will respond to them, evaluation of the lesson and assignment.

One major problem of lesson study is planning and design. CEMASTE (2005), "you are expected to implement lesson study programmed for four days in school but some counties took one to two days. Out of the twenty four lesson study sessions planned, only eleven had theme identified. It was evident that teachers were not able to differentiate between a theme and lesson study problem. For instance, in one centre the theme was relative speed as a universal concept in mathematics and sciences; differentiate soluble and insoluble salt". In Kenya, the best method to identify areas of need is by using annual Kenya National Examination Council (KNEC) Report and Training Needs Assessments (TNA) survey report. For example CEMASTE (2015) revealed that linear programming is a topic of concern that is challenging to both teacher and learner. This topic, therefore offer an opportunity for a lesson study. KNEC (2013) indicated that quite a number of learner have difficulties in answering some questions from waves concept. Based on TNA report (CEMASTE 2015) the topic "electrochemistry" showed that teachers and students find the topic difficult to teach and to learn respectively. Beside the KNEC (2013) report shows that student are inadequately grounded in the content knowledge of electrochemistry. The difficult may be due to abstract nature of topic. One way of making the lesson less abstract is through lesson study. Despite the importance attached to problem solving, finding of a survey on training needs of teacher (CEMASTE, TNA Report 20015) showed that teachers rarely provide learners with opportunities to solve non familiar problems. This state of affair is also reflected in examination performance where real world questions or problems in mathematics and sciences are avoided by most candidates (KNEC Report 2012 and 2013). These can be addressed through lesson study.

8.2. A critical analysis of the effectiveness of teaching and learning materials in mathematics and science pedagogy

In order for the learning materials to be considered effective, first they must be used to meet set of instructional objectives, that is must be used for what they were intended for. Secondly, the learning material must motivate the learners; they must be attractive and a rose the interest of the learners. Thirdly, the must not pollute the environment; there use must not expose learner into risk, that is must be user and environment friendly. Fourthly, the materials must be readily available and reliable; they must be free from errors in order to give accurate and

reliable results. Finally, the cost of obtaining them or producing them must be reasonable. Mathematics and science teachers are encouraged to improvise materials where possible to minimize cost, test for safety and reliability.

The days before establishment of internet as a major source of the information, many teachers were frustrated in obtaining teaching and learning materials which could be suitable to students. The days of limited and resources are gone. Scarcity necessitated choice and preferences. Through internet connectivity, teaching and learning resources have become abundant. We are now suffering from information obesity. There are many websites that have a wealth of resources materials needed for lesson study. The major problem is not accessing information or resource materials but filtering it out in order to meet the demand in teaching.

It is clear that materials are available. The challenges are with the teachers on how to obtain them, filter, provide range of materials, and identify appropriate teaching and learning materials, criteria to use to evaluate the resources, advantages and limitations of using resources available, how to incorporate these resources in teaching and learning, benefits of the resources to the learners.

8.3 A critical analysis of the effectiveness of lesson implementation in mathematics and science pedagogy

This involves one team member teaching and other observing and gathering evidence during the lesson without judgments to share during reflection. They record the interaction between teachers and students, students and students, common misunderstanding the students have, variety that individual student use to solve problem. The group should avoid side conversation, teacher evaluation and serving as an additional teacher in the classroom.

Whenever there is change in national curriculum, Japanese usually employ lesson study in order to effectively implement the new curriculum. is reversed, lesson study plays a critical role in the effective implementation of the new curriculum across the country (Takahashi 2014). Fuji (2014) studied the implementation of lesson study in some of the African country supported by Japan education and notes that many aspect of lesson study as practiced in Japan are left out. For example, lesson study observed in one county in Kenya took two days. Planning took one day while implementation and reflection the second day. In another county, they decided to fit it in one day. Planning was done in the morning, implementation in the afternoon leaving no room for reflection. It would take more than five weeks to complete study in Japan (Murata and Takahush 2002). TNA Report (CEMASTE A 2014), "one lesson, it was observed that there was limited time for ICT integrations possibly due to issues of planning time and of the animation display was faster than the content delivery. Teachers need to continuously improve on lessons implemented during lesson study activities and apply learnt concepts in the subsequent lessons in the school through the term and share back."

8.4. A critical analysis of the effectiveness of reflection in lesson study in mathematics and sciences pedagogy

Following the lesson the group has a post –lesson discussion at which the learning of the students is discussed in details using the observation notes made during the observation. According to

Stepanek, et al (2007), teachers are not experienced in observing and analyzing student learning activities. Teachers working in isolation will not be in a position to develop rich materials for lesson, refine observations skills required to gather reliable data. Lesson study team requires a lot of time to acquire and practice the skills required in reflection. In order for the study to be effective, the team needs to have an experienced or professional facilitator. The facilitator will help the team to explore deeper into lesson study. The lesson is the outcome of all the members hence each member feels responsible for the outcome of their plan. According to Bond et al (1985), it is through reflection that a practitioner is able to come up with new ideas that will help them to develop their professional knowledge. Successful lesson study reflection should include supportive and non-judgmental reflection. Every team player should comment on the lesson observed. It should be noted that reflection is not a debate. When the teachers are sharing comments, each observer should be given a chance without interruption.

Atwal and Jones (2009) suggested reflective practice builds up better levels of self awareness about practitioners and as individuals leading to opportunities for professional and personal development. For example during the lesson, the team can look into successes (what worked and what helped to produce positive result). Secondly, they can focus into the challenges (what didn't work and what need to be changed). Improve the next lesson by working on what need to be changed or added. This helps them to observe and come up with the solution of their classroom practices, enabling them to develop personal growth and professional development. However reflection can assist, the team member need to give a feedback with care, give what will help and not hurt the other member. Give concrete feedback which is less useful and often causes resentment.

Research findings

This article has found that ministry of education through CEMASTE A is very sensitive on in-service of mathematics and science teachers. This is done through SMASE INSETS and lesson study. There was evidence of collaborative planning; teachers choose lesson study theme, focused on the lesson and created the lesson as a team. They prepared an ASEI-PDSI lesson plan and worksheet together. However, there was minimal ICT integration in lesson plan.

During implementation, the lesson was taught by a member of the group. The introduction catered for the learner' prior knowledge on the topics, the objectives were clearly stated and relevant to the stated problems. During the lessons, there were relevant learning activities and collaborative learning among the students. In sciences, students were busy connecting, observing, sorting, classifying, recording, interpreting and doing calculations in the worksheets provided.

Learning resources were used during the lesson. in some schools, the resources were adequate while in others, they were inadequate though they were appropriate to the stated problem. In physics, some instruments used had zero errors. However, very few schools integrated ICT in their lessons. The use of ICT tools to prepare teaching and learning resources and materials were minimal or not available in most cases. There were evidence of innovation and improvisation during the lesson. Where funnels

were not available in some upcoming schools, teachers used plastic water bottles. Some teachers used mobile phone as an ICT tool. Where there was use of ICT tools, hands-on activities and group discussions, students were highly motivated to learn. Learners were given opportunities to give and discuss their observations and later teachers harmonized the learners' observations. Finally teachers gave lesson conclusion in relation to the objectives and stated problems.

The group got together to discuss the lesson and their observations. However, at this important stage, teachers allocated less time. Reflections were not adequate and mistakes were likely to be repeated. Revision to the lesson based on their observations and analysis were not appropriate and documentation of the findings not filed.

9.0.Conclusions

From the finds of the study, it can be concluded that lesson study has provided an ongoing strategies for improving teaching and professional development of teachers in Kenya. It has enabled the teachers to share and design best practices in education. A teacher is able to learn successful techniques and behaviors from other teachers. Students have benefited from improved lesson delivery, motivated by using hands-on activities, group discussions, integration of ICT in learning and use of problem-based learning (PBL) that advocates for the learner centered pedagogy.

Kenya adopted lesson study in order to come up with strategies of improving performance in mathematics and science in secondary school through SMASE project. Lesson study has been cascaded to all counties in Kenya and CEMASTEAs do the monitoring and evaluation. However effective ICT integration into the learning process is not adequate. ICT motivates and challenges students and hence develop problem-solving skills. Effective ICT integration makes the learning process more interactive and learner more active and engaged.

10.0 Recommendations

Mathematics and sciences hold key pillar in achieving Kenya Vision 2030, toward globally competitive and prosperous Nation. Therefore this study recommends the following:

- I. CEMASTEAs to strengthen their monitoring and evaluation team in order to cover all sub-counties in Kenya.

- II. Funding of lesson study to be centralized in CEMASTEAs headquarter.
- III. CEMASTEAs to hire qualified facilitator in every county or sub-county.
- IV. A facilitator manual to be available.
- V. All principals and deputy principals in secondary to embrace lesson study.
- VI. Teacher should be trained on how to use ICT tools as a teaching and learning material.
- VII. Duration of lesson study should be long enough to ensure lesson planning, resources development, try out through peer teaching lesson implementation and reflection, preferably one week.
- VIII. Lesson plan should be tried out through peer teaching before actual classroom implementation to minimize misconceptions and errors arising from lesson activities.

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